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Unemployment in Canada

Frictional, Structural and Cyclical Aspects

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Unemployment in Canada

The findings of this study are the personal responsibility of the author and, as such, have not been endorsed by the Members of the Economic Council of Canada.

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Foreword

The rate of unemployment is among the most common of economic indicators, its implications are well known and easily understood. When the unemployment rate is high, times are tough and job security is low. When the unemployment rate is low, jobs are plentiful and times are good. At the personal level high unemployment rates are bad and low rates are good.

At the policy level, however, the implications of a low unemployment rate are less clear-cut. Low unemployment rates imply higher output, lower social welfare costs and a happier and more satisified population. However, low unemployment rates can also imply over capacity utilization, tight labour and factor markets and inflation. As recent history has made only too clear, high and volatile inflation carries with its own significant personal and social costs.

It is the role of modern policy-makers to lead a fiscal and monetary policy which balances between the competing objectives of a low unemployment rate and stable prices. In order to pursue an informed unemployment/inflation policy, politicians must have a clear idea of what the lowest rate of unemployment consistent with stable inflation might be. In the jargon of the economist it is crucial to know, or at least have an idea as to the *natural* rate of unemployment.

This paper provides an estimate of the *natural* rate of unemployment. In addition, it describes and quantifies the influences which various factors have had on the *natural* rate over the last quarter of a century. The analysis suggests that by the beginning of 1987 most of the unemployment in Canada was structural in nature. The breakdown of factors' contribution towards the rise in structural unemployment points towards the kind of policies most susceptible to reducing structural unemployment; policies such as improving the match between workers' skills and employers' needs as well as policies aimed at improving the incentive structure of various social programs. Policies which seek to reduce unemployment through traditional fiscal and monetary policies are likely to be frustrated by higher rates of inflation.

This paper was prepared by Andrew Burns, an economist on the staff of the Council. It was undertaken as part of the Council's assessment of Canada's medium term performance and outlook for its 25th Annual Review, *Back to Basics*. The findings of this study are the personal responsibility of the author and, as such, have not been endorsed by the members of the Economic Council of Canada.

Judith Maxwell
Chairman

Abstract

The paper presents a quarterly estimate of the natural rate of unemployment (NRU) in Canada over the period 1963-1987. The paper notes that previous efforts in this regard have resulted in estimates of the NRU in 1983 ranging from as low as 7.3 to as high as 11.0 per cent. Estimates which follow the Lilien methodology of modelling changes in frictional unemployment by an employment dispersion index are investigated and found to be biased. The Lilien proxy (SIG) is found to lose much of its explanatory power when confronted in the same regression with explicitly cyclical variables. For the years 1963, 1973, 1983 and 1987, the natural rate is estimated to have been 4.3, 6.2, 8.4, and 7.6 per cent respectively. Although rejecting Lilien's proxy, the analysis finds in favour of Lilien's argument that a significant proportion of the increase in unemployment was caused by increased mismatch in labour markets. The increase is modelled by the relative price of energy, changes in which (as in the works of Hamilton) are thought to have altered the pattern of demand and thus industrial employment as well as affecting unemployment through the traditional supply side channels. Minimum wage legislation, labour market power, changes in social attitudes towards work, tax based distortions (tax wedge) and hysteresis are also found to have had significant unemployment effects. A distinction is drawn between dynamic and steady state natural rates. It is argued that for short-term policy purposes the dynamic natural rate might be the more appropriate indicator. In addition the paper outlines a useful methodology for disaggregating effects (almost exactly) in highly non-linear systems.

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Introduction

Unemployment in Canada has followed a steady upward trend over much of the last 25 years. Leading models of the unemployment rate differ considerably in the extent to which they attribute this rise to cyclical as opposed to structural/frictional factors. This paper presents a model which permits measurement of the relative importance of the various causes of the rise in unemployment, and a measurement of the structural, frictional and cyclical components of unemployment in Canada.

Recent models of the unemployment rate (Lilien (1982) in the U.S. and Samson (1985) in Canada) have used a reduced form methodology which attributes much of the recent rise in unemployment rates to the effects of changes in industrial structure. Estimates of the natural rate of unemployment (NRU) deriving from these studies have been very close to the observed rate of unemployment and significantly higher than estimates of the non-accelerating inflation rate of unemployment (NAIRU) deriving from a Phillips curve methodology (Gordon (1985) in the U.S. and Fortin (1988) in Canada). Abraham & Katz (1986) and Ratti (1985) have presented evidence that Lilien's measure of structural unemployment was contaminated by cyclical elements. Louangi (1986) presents further evidence suggesting that the proxy used in these studies is endogenously determined by the relative price of energy. McCallum (1986, 1987) finds support for restrictive monetary policy in recent unemployment rises as well as evidence of increases due to structural change. McCallum presents evidence that exogenous resource prices were causal of the structural change and rejects the Lilien/Samson modelling methodology. Although not designed as an estimate of the NRU, McCallum's (1986, 1987) results are consistent with a NRU lying between the extremes represented by Samson and Fortin.

Recent unemployment experience in Europe has brought into question the notion of a natural rate of unemployment. Blanchard & Summers (1976), Hargreaves Heap (1980), Lindbeck and Snower (1987), Hall (1988), Barro (1988) and many others have popularized the concept of unemployment hysteresis. These authors argue that there is an asymmetry in labour markets which prevents workers who have been laid off from being easily rehired. This theoretical position is given empirical support in the findings of Marston (1976), Clark & Summers (1979), and Hasan & de Broucker (1981, 1982),

whose research shows that an increasing proportion of the measured unemployment rate can be accounted for by a relatively small number of long-term unemployed.

As this brief overview of the recent literature suggests, there is something less than an unanimous opinion as to the actual cyclical position of the economy. Existing NRU estimates suggest that the economy is at or near full employment; NAIRU estimates suggest that there is considerable slack; while the theoretical implication of hysteresis throws the whole notion of a natural rate into question.

This paper attempts to address these ambiguities by integrating and extending Samson's and Fortin's work by: a) employing quarterly data; b) enlarging the sample period to cover 1963Q1 through 1987Q2; and c) developing a reduced form model of unemployment which explains the persistence of unemployment, permits measurement of the relative importance of the structural, cyclical and frictional components of unemployment, and presents new empirical evidence on the hysteresis phenomenon.

The paper is divided into six sections, the first being this introduction. The second section presents Lilien and Samson's model of the unemployment rate. A discussion of the implications of the Lilien modelling technique concludes that the principle difficulty with the Samson/Lilien estimates lies in a mis-specification of their design matrix. The third section presents a brief review of factors likely to affect the labour supply/labour demand relation. Section four incorporates these factors into a reduced-form regression whose properties are discussed. Section five presents an analysis of the contribution of different causal factors to the unemployment rate. It compares the impact implied by our reduced form equation with results drawn from other sources and concludes that the estimates do not conflict with our knowledge of economic events.

The final section of the paper reviews the major findings and comments upon their implications for the structural-cyclical debate.

Lilien and Samson's NRU

Lilien's (1982) paper follows Barro's (1973) basic methodology in modelling unemployment. Lilien extends Barro's technique by adding an employment dispersion variable which is meant to allow testing of

the hypothesis that rises in the unemployment rate are a function of structural change between industries. Samson (1985) reproduced a variant of Lilien's model to test the same hypothesis, using Canadian data.

Lilien argues that unemployment which derives from changes in the rate at which industrial sectors expand and contract is properly measured as structural unemployment. These changes will be reflected in changes in sectoral employment growth statistics. Lilien's measure of employment dispersion (SIG) is defined as the square root of the sum of the change in the rate of sectoral employment growth less the change in aggregate employment growth weighted by sectoral labour force share. Mathematically,

$$SIG = [\Sigma(e_{it}/E_t)(\Delta \ln e_{it} - \Delta \ln E_t)^2]^{1/2} \quad (1)$$

where e_{it} is employment in sector i at time t and E_t is total aggregate employment.

The Lilien technique consists of regressing an unemployment variable on past unemployment, a demographic proxy, monetary surprises, the employment dispersion variable (SIG) and a time trend. Samson expands on this technique by including the U.S. unemployment rate as an explanatory variable on the grounds that Canada and the U.S. are important trading partners and that the business cycle can be transmitted from the larger U.S. economy to the smaller Canadian.

Samson and Lilien's estimates are made with annual data. In order to assure compatibility between our quarterly and Samson's annual data set we have reproduced Samson's estimates. Samson's SIG variable was derived from an 11 sector disaggregation of employment statistics; due to data constraints imposed by our quarterly data-base and our more recent sample period, our SIG variable is derived from an eight-sector disaggregation.[1] The results of our regression are reproduced below.

Under the Lilien methodology the natural rate of unemployment (NRU) can be calculated by setting monetary innovations to zero and using the estimated regression coefficients to solve for a cyclically corrected NRU. Our estimate of the NRU derived from Samson's

basic methodology and Samson's original result are reported in Table 1.

Table 1

NRU Calculated Using Samson Methodology

	Samson's Estimate	Quarterly Estimate	Actual UR
1963	5.00	3.13	5.49
1964	4.10	3.10	4.65
1965	4.10	3.30	3.86
1966	3.50	3.27	3.33
1967	4.00	3.17	3.82
1968	4.30	3.22	4.48
1969	3.90	3.12	4.42
1970	4.70	3.71	5.71
1971	5.00	4.63	6.19
1972	5.10	5.24	6.23
1973	4.90	5.25	5.54
1974	5.30	5.40	5.33
1975	7.10	6.85	6.92
1976	7.30	7.67	7.13
1977	7.90	7.68	8.10
1978	7.70	7.19	8.34
1979	7.40	6.98	7.42
1980	7.90	7.45	7.46
1981	8.20	8.18	7.55
1982	10.60	9.31	11.07
1983	11.00	10.45	11.87
1984		9.88	11.28
1985		9.24	10.51
1986		9.03	9.60

QUARTERLY data for 96 periods from 1963Q2 to 1987Q1

$$\begin{aligned} UR = {} & 1.30116 * UR[-1] - 0.43621 * UR[-2] + 9.95718 * SIG \\ & (13.9082) \qquad (5.21901) \qquad (1.60902) \\ & - 5.62427 * DMR1[-1] + 4.83178 * LABR + 0.09389 * NRUT \\ & (2.56898) \qquad (3.56316) \qquad (2.84270) \\ & - 1.51746 \\ & (3.73724) \end{aligned}$$

Sum Sq	7.3218	Std Err	0.2868	LHS Mean	6.9684	
R Sq	0.9877	R Bar Sq	0.9869	F 6, 89	1190.47	(2)

Where UR is the unemployment rate, SIG is our employment dispersion variable, DMR1 are monetary innovations, LABR is female workers labour force share, and NRUT is the U.S. unemployment rate.[2]

Except for the early 1960s, where significant differences between our reproduction of Samson estimate and her original exist, our estimate reflects Samson's result. Given data differences and the difference in periodicity, we are inclined to feel that the estimates are sufficiently similar that further results and conclusions derived from our data base would hold if Samson's original data were used.

Lilien's (and Samson's) results were, and remain, quite controversial. One of the key criticisms made is that their measure of inter-sectoral mobility may not be free of cyclical influences. Abraham and Katz (1986) examine Lilien's work and present results which suggest that the employment variance variable is in fact a function of cycles in the economy. This concern is echoed in Ratti (1985) who concludes "that cyclical factors explain much of the differential in sectoral rates of employment growth". If one accepts this conclusion, it follows that Lilien's and Samson's natural rate contains a considerable cyclical element, and calls into question the "naturalness" of their estimate.

In an effort to determine the causality underlying the correlation between SIG, our sectoral employment variation variable, and the unemployment rate, we performed a test of Granger-Sims causality. We tried the test both with unfiltered data and with filtered data following Sims (1972).[3] Our results were inconclusive; they were, however consistent with a situation where causality runs from a third factor, such as deviations from potential output to both SIG and the unemployment rate.[4]

The failure of statistical tests to provide meaningful insights on the causal nexus between SIG and the unemployment rate leaves us in something of an interpretive quandary. It seems clear from the research cited above that at least some of the correlation between SIG and the unemployment rate is cyclical in nature. It seems equally reasonable, however, that some of the correlation reflects the kind of changing structural patterns originally hypothesized by Lilien.

By limiting their regressions to a few regressors, Lilien and Samson run the risk of generating biased and inefficient estimates.[5] The fact that their regressions do not contain any specifically cyclical variables aside from monetary innovations, makes interpretation of the SIG variable difficult. The inclusion of expressly cyclical regressors would ensure that any cyclical information in SIG would be orthogonalized and would permit a more explicit interpretation of SIG's influence as an indicator of structural unemployment. In general, by expanding the set of economically sensible explanatory variables one reduces the risk of bias and increases the analytic content of a model.

Re-specification:

Ratti and Abraham & Katz take Lilien to task for his failure to incorporate any explicitly cyclical variables in his regressions. His, and Samson's, modelling can be further criticized for their failure to account for a number of economic, social and institutional factors which most certainly influenced the relationship between measured labour supply and labour demand. Their failure to explicitly model the two oil shocks in the 1970s is just one example of an economic event exogenous to their design matrix which has been omitted in estimation.[6]

Naturally, no econometric model can hope to correctly measure and model all influences. This is especially true when one is attempting to model the unemployment rate, where so many factors undoubtedly play a role in its determination. The wide range of potential causal variables makes a nested hypothesis testing procedure, in the strict sense, unworkable. Our modelling strategy is, therefore, something of a compromise. Based upon a search of the recent literature, we unearthed a number of factors which have been either hypothesized as being, or found to be, important determinants of the unemployment rate. After a certain amount of experimentation with different proxies and with alternative functional forms we arrived at the following expression for the unemployment rate.

$$\begin{aligned}\log(\text{PERRYU})_t = \alpha &+ \beta_1 \log(\text{PERRYU})_{t-1} + \beta_2 \text{DMR1}_t \\ &+ \beta_3 \text{SIG}_t + \beta_4 \log(\text{USGAP})_t \\ &+ \beta 5 \text{ENERGSHK}_t + \beta_6 \text{CUR}_t \\ &+ \beta_7 \text{RLPENERG}_t + \beta_8 \log(\text{WMR})_{t-4} \\ &+ \beta_9 \text{UNION}_t + \beta_{10} \text{HYSTERESIS}_t \\ &+ \beta_{11} \text{UIOPP}_t + \beta_{12} \text{INFLVAR}_t \\ &+ \beta_{13} \text{MSERM}_t + \beta_{14} \text{BDTAX}_t \\ &+ \beta_{15} \text{RDIRTAX}_t + \beta_{16} \text{RINDTAX} \\ &+ \beta_{17} \text{MONPOL} + \delta_t \qquad (3)\end{aligned}$$

With a few minor changes, the first four regressors are the same as those we used in reproducing Samson's estimate of the NRU. The variable LABR does not appear in this expression because we have corrected for demographic effects by using as the dependent variable a fixed weight unemployment index (PERRYU).[7] The second change lies in the specification of the U.S. business cycle proxy. Here we use USGAP, defined as the U.S. rate of unemployment less the U.S. natural rate adjusted by a constant.[8] Statistically, we can test the adequacy of the Samson model by testing the null hypothesis that $\beta_i = 0$ for all $i = 5..17$.[9]

The choice of PERRYU as our unemployment variable was motivated by the potential effect which changes in labour force composition, demographic and otherwise, might have on the unemployment rate. An increase in the proportion of the workers with a relatively high marginal propensity to be unemployed would tend to increase the unemployment rate and the NRU without any change in the economic factors dictating labour supply and demand. An increase in the aggregate unemployment index (PERRYU) must reflect some factor other than changing participation rates or changes in the demographic make up of the work force.[10]

Aside from the persistently high rates of unemployment which have been observed over the 1970s and 1980s one of the most perplexing economic events has been the decline in labour productivity in the western economies. Many authors[11] present models where a real wage gap -- that is, the difference between workers' marginal productivity and the real wage they demand -- is cited as an important factor in the secular rise of unemployment. Central to these arguments is the notion that workers failed to perceive a drop in their productivity and that they, therefore, demanded and, osten-

sibly, received a real wage which exceeded the marginal product of the marginal walrasian equilibrium worker. As a result, employment was inferior to its equilibrium value and there existed positive classical unemployment in the sense of Malinvaud (1982).

Normally changes in productivity are not exogenous, but rather the result of other factors operating in the economic environment. In the context of a reduced-form equation the preferred modelling technique is to include as independent variables those which are theoretically causal. The theory of the firm suggests that labour productivity is a function of the firm's position on its short run production function, technological change and, with a given labour force, the supply of other factors of production: materials and capital. We model the productivity slow down by its proximate causes, the rise in the relative price of energy RLPENERG[12] and changes in the rate of capacity utilization, CUR.[13] By modelling CUR directly we immediately address Abraham & Katz and Ratti's concern with respect to the absence of explicitly cyclical factors in reduced-form estimates of the unemployment rate.

It is often argued that there has been a change in the opportunity cost of being unemployed. Fortin (1984) provides a simple modelling of the terrain upon which the employment not employment decision is made. Factors such as the generosity of unemployment insurance programs, the generosity of the social welfare system and UIC eligibility rules all effect the labour market behaviour of workers and firms and the natural rate of unemployment.[14]

We follow Fortin (1989) by accounting for changes in the generosity of the unemployment insurance system with his unemployment insurance generosity index UIOPP.

Minimum wages are another important factor affecting both the firm's decision to offer employment and a worker's decision to accept any given offer. Minimum wages act as a price floor and may result in some low productivity jobs not being offered and therefore in an excess supply of workers at the going wage (involuntary unemployment). In addition we hypothesize that the ratio of minimum to average industrial wages (WMR) will be positively correlated to the generosity of the social welfare system as a whole. Thus WMR represents a proxy for both the price floor effect of minimum wage legislation and the effect of a reduced opportunity

cost of unemployment implied by an increase in the generosity of the social welfare system.

One possible explanation for increases in the measured rate of unemployment has its roots in a general reduction in labour force attachment reflecting a decrease in the subjective opportunity cost of unemployment. A potential indicator of changes in attachment to the work force and perhaps of changes in the work ethic is the youth school enrolment rate, the percentage of the youth population intending to return to school (MSERM). An exogenous increase in the marginal disutility of work should result in an increase in consumption of substitute goods such as school.[15] According to search theory, if the preference change which caused the substitution away from work also manifests itself as a decrease in labour force attachment, there will be an increase in the average number of spells of unemployment and an increase in the rate of unemployment. Similarly, if exogenous factors causing a substitution away from work also manifest themselves in an increase in the propensity to report oneself as unemployed in order to gain benefits, one would expect school enrolments to be positively correlated with the measured unemployment rate.

An important theme in the unemployment literature is the effects of price system distortions (see Gordon (1988), Bean, Layard and Nickell (1986) and Fortin (1989) *inter alia*). Increases in taxes paid by firms causes the real wage paid by firms to rise while increases in taxes to workers cause the real wage received to decline. The combined effect is to drive a wedge between the marginal productivity of workers and the wage they receive (equated with the marginal dis-utility of work). Further, increases in the marginal tax rate decrease the incentive to work and result in more "measured" unemployment.

The effect of an increased wedge on the unemployment rate is uncertain because although both a business and personal tax reduce employment it is not clear whether the decrease in labour demand will exceed the decrease in labour supply implying increased unemployment. We model these effects with three variables RDIRTAX, RINDTAX and BDTAX; which are the ratios of personal direct taxes (including CPP and UIC payments), and of personal indirect taxes to labour income and finally of business taxes to GDP.

Price distortions can also enter into the system through deviations from the perfectly competitive model. It is often argued that unions tend to demand real wages which exceed their marginal product. As a result they cause a gap between the economy's warranted real wage and the actual real wage resulting in "classical" unemployment. If indeed unions do generate monopoly type distortions we would expect the unemployment rate to be a positive function of the proportion of the labour force who are members of unions (UNION).

Lucas (1973) noted that the sensitivity of unemployment to inflation in different countries was dependent upon the inflation history they had experienced. Similarly Baily (1974) and more recently Levi & Makin (1980) have presented models where increases in the variation of inflation result in a deterioration of an individual's ability to predict future price levels and therefore an increase in the perceived degree of risk when entering into future contracts generally and employment contracts in particular. Risk averse firms impute a wage premium which results in fewer offers being made and, cæteris paribus, a reduction in employment. We hope to capture the influence of changes in the volatility of the price environment by INFLVAR, the inflation variance over the previous eight quarters.

Among the factors normally hypothesized as influencing unemployment are unanticipated price shocks and, in the Keynesian literature, the relative pro-active nature of monetary and fiscal policy. We model innovations in two ways. The first is a measure of energy sector innovations and is meant to capture the short run "surprise" effect of the oil shocks. It is defined as the rate of inflation in the energy sector less expected inflation. The second is monetary innovations defined as the residuals from a regression on the money supply growth (DMR1).[16]

McCallum (1986) found that a significant degree of unemployment could be accounted for by changes in government monetary policy. We model changes in government policy (MONPOL) as the deviation of anticipated money supply growth from the inflation rate. Positive values imply an activist monetary policy while negative values are indicative of restraint.

The fact that the unemployment rate, and most estimates of its natural rate, have increased in a steady fashion throughout much of the last quarter of a century has led many authors to question the

meaningfulness of the natural rate concept [see Gordon (1985)]. In a 1980 paper Hargreaves Heap argued that the behaviour of unemployment rates was consistent with a model where the natural rate follows a random walk. His analysis was presented in part as a rebuttal of the notion of "natural" rates *per se* and in part as an explanation as to why the natural rate might change over time.

Stated succinctly, he argued that unemployment results in a deterioration of human capital. A bout of unemployment may cause a worker to become unemployable at the "going wage". If workers fail to revise their expectations, a wedge is driven between their expectation of their market wage and its realization. As the duration of unemployment increases, work skills and work habits continue to deteriorate. At the same time, the stigma of a period of prolonged unemployment contributes to a further devaluation of workers' skills and, potentially, to a further increase in the wedge between their reservation wage and the market's evaluation of their marginal product.

Blanchard and Summers (1986) develop a more detailed model of the hysteresis phenomenon. They propose a model where the wage bargaining process is characterized by an insider/outsider ethos. Those presently employed and those recently employed constitute an insider group which behaves as a monopoly, negotiating wage settlements so as to maximise the welfare of the group's members with no consideration of outsiders' welfare. They demand a wage equal to the rational expectation of the marginal product of their membership which results in an expected level of employment equal to what it was in the last period. Supply shocks in the system can result in realized employment being greater or less than the present membership.

Membership in the insider group is earned by employment and the first employed each period are members. Thus, unemployed workers and non-members are synonymous terms in the model. The only way by which non-members can become members, and therefore for the level of "natural" unemployment to decline, is for a positive demand shock to cause demand for labour to exceed the membership, in which case the membership expands to include the newly hired workers.[17] Similarly a negative demand shock has the effect of reducing the membership roles. Assuming that shocks are randomly and normally distributed with mean zero, hysteresis based unemploy-

ment will follow a random walk, as will the "natural" rate of unemployment.[18]

The Blanchard and Summers paradigm is consistent with the Hargreaves Heap story. Recent employment or a stable employment history become requisites for club membership. If one is willing to stretch the analogy the quality of one's club membership, and thus the probability of employment, will be a function of past work experience. Viewed in this light at least some of the recent increases in the unemployment rate and in the "natural" rate of unemployment might usefully be termed "hysterical".

The hysteresis effect is captured by inclusion of the lagged independent variable in our regression. The coefficient on lagged unemployment (β_1) imposes a pattern of decay on structural variables. The larger it is the more time it takes for the full impact of a shock to be felt. In a pure hysteresis model β_1 would be 1.0 suggesting the effects of a given shock is permanent and immediate. In the persistence model it is bounded by zero and one. A coefficient close to one suggests that a positive shock to unemployment continues to add to the unemployment rate long after the initial event. In a period where positive shocks are more numerous than negative, the curative effects of subsequent negative shocks could be lost in the after shocks of previous positive shocks. A relatively large coefficient implies persistence[19] of shocks over a long period, which we term hysteresis.

More explicitly Blanchard and Summers see hysteresis/persistence as a function of unions. Although they admit that hysteresis producing behaviour is not uniquely a characteristic of unions the implication of their paper is that the more unionized an economy becomes the more prone it will become to this phenomenon. The variable HYSTERESIS is defined as union members as a percentage of the labour force times a one period lag of the change in the unemployment index.

We use union membership multiplied by changes in lagged unemployment, as opposed to union membership or changes in unemployment alone, because the Blanchard and Summers' argument is not that the level of unemployment *per se* will be affected by insider/outsider behaviour, but rather that given changes in the level of unemployment will have a tendency to be institutionalized the

more the economy exhibits insider/outsider characteristics.[20] The HYSTERESIS variable allows modelling of changes in the degree to which labour markets are characterized by insider/outsider behaviour. As insider/outsider behaviour increases, the impact on the NRU deriving from a given cyclical or structural shock increases, as does the degree of unemployment in subsequent periods as modelled through the β_1 coefficient.

Estimation

Although the set of explanatory variables detailed above is not exhaustive of all potential predetermined variables in the unemployment rate's reduced-form, (the set of such factors is infinitely large), we feel that it does cover all of the bases. We propose equation (3), reproduced below, as our most general specification of the unemployment relation and proceed to estimate the equation following a strategy of nested hypothesis tests.

$$\begin{aligned}\log(\text{PERRYU})_t = \alpha &+ \beta_1 \log(\text{PERRYU})_{t-1} + \beta_2 \text{DMR1}_t \\ &+ \beta_3 \text{SIG}_t + \beta_4 \log(\text{USGAP})_t \\ &+ \beta_5 \text{ENERGSHK}_t + \beta_6 \text{CUR}_t \\ &+ \beta_7 \text{RLPENERG}_t + \beta_8 \log(\text{WMR})_{t-4} \\ &+ \beta_9 \text{UNION}_t + \beta_{10} \text{HYSTERESIS}_t \\ &+ \beta_{11} \text{UIOPP}_t + \beta_{12} \text{INFLVAR}_t \\ &+ \beta_{13} \text{MSERM}_t + \beta_{14} \text{BDTAX}_t \\ &+ \beta_{15} \text{RDIRTAX}_t + \beta_{16} \text{RINDTAX} \\ &+ \beta_{17} \text{MONPOL} + \mu_t \end{aligned} \tag{3}$$

Table 2 below reports our regression results, starting with regression (1) our most general formulation and moving to the right as more restrictions are added until we arrive at regression (7) our final model of the unemployment rate.

Looking at regression (1) the coefficients on the lagged unemployment index variable (PERRYU), our social attitude proxy (MSERM), the capital utilization rate (CUR), monetary policy proxy (MONPOL), the minimum wage variable (WMR), the energy price surprise variable (ENERGSHK), the relative price of energy productivity proxy (RLPENERG) and the hysteresis proxy (HYSTERESIS) all have the correct sign and are conditionally different from zero at the five per cent confidence level.

Table 2

Coefficient Estimates from Reduced Form Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$LnPERRYU_{t-1}$	0.7663 (15.69)	0.7442 (13.62)	0.7456 (14.60)	0.7251 (13.26)	0.7667 (15.89)	0.7512 (16.41)	0.7579 (8.84)
MSERM	1.0305 (2.21)	0.9296 (1.98)	1.1936 (2.49)	1.1064 (2.29)	1.0152 (2.22)	1.0327 (2.25)	0.9737 (2.13)
CUR	-0.0054 (2.76)	-0.0056 (2.91)	-0.0053 (2.77)	-0.0050 (2.67)	-0.0060 (3.09)	-0.00596 (3.63)	-0.0060 (3.67)
MONPOL	-1.0085 (2.93)	-1.0488 (3.06)	-1.1384 (3.24)	-1.1540 (3.33)	-1.0264 (3.04)	-0.97526 (2.92)	-0.9210 (2.77)
$LnWMR_{t-4}$	0.29136 (1.92)	0.26372 (1.73)	0.28136 (1.88)	0.26662 (1.80)	0.27665 (1.87)	0.27111 (1.83)	0.2710 (1.86)
LnUSGAP	0.01903 (1.24)	0.01951 (1.28)	0.02381 (1.52)	0.02685 (1.74)	0.01545 (1.11)	0.02092 (1.64)	0.0229 (1.82)
ENERGSHK	-0.4789 (3.20)	-0.3905 (2.25)	-0.4180 (2.73)	-0.3451 (2.05)	-0.4886 (3.20)	-0.48271 (3.31)	-0.4864 (3.36)
UNION	0.61583 (0.69)	0.24029 (0.25)	0.43233 (0.49)	0.21762 (0.25)	0.43464 (0.52)	0.5132 (0.62)	0.3891 (0.47)
RLPENERG	0.39188 (2.62)	0.39183 (2.64)	0.35292 (2.51)	0.35698 (2.60)	0.38485 (2.82)	0.39522 (2.90)	0.3700 (2.74)
HYSTERESIS	0.55970 (1.65)	0.62495 (1.81)	0.64482 (1.89)	0.71491 (2.06)	0.54454 (1.63)	0.57934 (1.75)	0.5253 (1.59)
BDTAX	0.28907 (0.44)	0.52415 (0.76)	1.89714 (1.36)	2.06376 (1.53)	0.27586 (0.43)	0.18972 (0.30)	0.3183 (0.50)
DRM1	0.43881 (1.35)	0.39942 (1.22)	0.46945 (1.46)	0.43462 (1.36)	0.43043 (1.35)	0.42109 (.32)	
SIG	0.96156 (1.07)	1.02286 (1.14)	0.81188 (0.90)	0.92339 (1.04)	0.88946 (1.01)		
RDIRTAX			-1.26990 (1.28)	-1.22195 (1.32)			
RINDTAX		-0.83152 (0.91)		-0.78387 (0.95)			
UIOPP	-0.00524 (0.56)	-0.00069 (0.07)	-0.00037 (0.03)				
INFLVAR	7.69120 (0.26)						
CONSTANT	0.17995 (0.52)	0.38161 (0.99)	0.19277 (0.58)	0.31065 (0.97)	0.27886 (0.95)	0.27313 (0.93)	0.32755 (1.14)
R^2	0.9905	0.9906	0.9907	0.9908	0.9905	0.9904	0.9902
$\bar{R}^2$	0.9887	0.9888	0.9890	0.9891	0.9890	0.9890	0.9890
Q(4)	1.77	2.02	1.42	1.66	1.75	1.50	2.67
Q(8)	5.91	7.36	3.78	4.69	5.95	5.49	8.63

The USGAP measure is correctly signed and significantly different from zero at the ten per cent confidence level.

DMR1, the unanticipated monetary shocks variable, is significant at the ten per cent level but insignificantly different from zero at the five per cent level and is incorrectly signed. This result and the fact that deviations of anticipated monetary policy from its neutral rate have a non zero effect is in apparent conflict with the predictions of rational expectations.

The incorrect sign of the innovations term is especially troubling. One possible explanation for this result is that expectations have been mis-measured. This hypothesis is countered by the fact that the same innovations variable was both significant and correctly signed when included in the Samson reduced-form. The change in DMR1's sign from the Samson type regressions to our general model may merely reflect the fact that the cyclical information in DMR1 has been orthogonalized by the inclusion of additional explanatory variables.[21] As indicated by its t score the remaining information is statistically insignificant. We proceed by leaving the DMR1 variable in the regression despite its marginal significance and incorrect sign with an eye to reevaluating it at a later point.

Samson's employment variation variable (SIG), on the basis of its t statistic, is conditionally insignificant as are the inflation variance variable INFLVAR, and Fortin's measure of unemployment insurance generosity UIOPP. An F test, based upon regressions (1) and (5), of the null hypothesis that the coefficients on INFLVAR, UIOPP,and SIG are jointly zero cannot be rejected $F(3,81) = 0.27$ at commonly used levels of significance.

The insignificance of SIG could be seen as supportive of the arguments put forth by Ratti (1985) and Abraham and Katz (1986), which suggest that SIG reflects largely cyclical factors. However, it is also compatible with the hypothesis that SIG contains no additional information about structural unemployment over and above that embodied in other explanatory variables (specifically RLPENERG). The insignificance of SIG in a more fully specified model is a result reflected in McCallum (1986, 1987) and Collyns (1984).[22]

Tests of coefficient stability, Cusum and Cusum^2, fail to reject the null hypothesis of parameter stability for both forward and backward

recursive regressions. These statistical tests are backed up by evidence indicating that coefficient estimates stabilize after 48 quarters. Taken together with the high R^2 for the final regression and the apparent absence of serial correlation in the residuals $Q(8) = 8.48$, the model would appear to be well specified and relatively complete.

Equations (2)-(4) introduce the consumer tax variables RDIRTAX and RINDTAX which have been described earlier and which were left out of (1) due to software constraints. Regression (2) drops the insignificant variable INFLVAR and adds RDIRTAX. RDIRTAX takes on the correct sign but is insignificant at the five per cent level. Similarly RINDTAX in regression (3) is insignificant. Regression (4) drops UIOPP and includes both RDIRTAX and RINDTAX, which continue to have correct signs but to be conditionally and jointly insignificant ($F(2,82) = 1.84$).

Regression (6) drops SIG as insignificantly different from zero and regression (7) finally drops DMR1, which remains insignificant throughout the estimation process. Coefficient estimates were not sensitive to DMR1's exclusion, which supports the view that it has been orthogonalized. An F test of the totality of restrictions incorporated from model (1),(5)-(7) was unable to reject the hypothesis that all excluded variables had coefficients of zero ($F(4,82) = 1.34$).

Accounting for the NRU

The existence of hysteresis or persistence complicates the calculation of the natural rate of unemployment. Historically natural rates and NAIRUs have been calculated as steady state concepts; the rate of unemployment which would hold once all adjustments had occurred. This steady state NRU (SNRU) can be calculated in one of two equivalent ways:

(1) The SNRU for time t can be calculated from the recursive (in "i") equation (4), where all cyclical variables have been set to their normal values and, for simplicity, are represented by CYCL. Repeating this process for each and every t we can simulate the time path of the steady state NRU.

$$SNRU_{t,i} = \exp(\beta_1 SNRU_{t,i-1} + \beta_2 RLPENERG_t + \beta_4 HYSTERESIS_t + \beta_5 \ln(WMR_{t-4}) + \beta_6 BDTAX + \beta UNION_t + \beta_8 MSERM_t + (\beta_9 CYCL_t + \alpha)) \quad (4)$$

(2) Alternatively one can rewrite (4) as

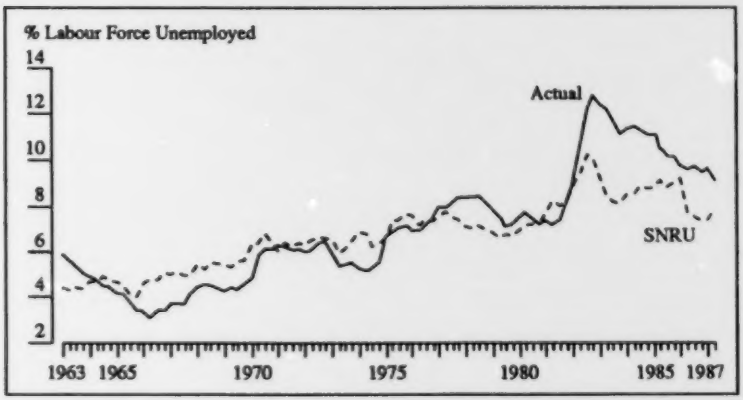
$$SNRU_t = \exp([1-\beta_1]^{-1} \cdot [\beta_2 RLPENERG_t + \beta_3 MANT_t + \beta_4 HYSTERESIS_t + \beta_5 \ln(WMR_{t-4}) + \beta_6 BDTAX_t + \beta_7 UNION_t + \beta_8 MSERM_t + \beta_9 CYCL + \alpha)]) \quad (5)$$

which is computationaly identical to (4) above.[23] Chart I and Table 3 show the SNRU as calculated from (4) or (5) above and the historical unemployment rate.

Our estimate of the SNRU[24] (reported in annualized tabular form in Table 3 and in quarterly format in Chart 1 lies well within the bounds established by Samson's estimate of the NRU and Fortin's estimate of the NAIRU. Our estimate of the SNRU in 1984 is

Chart 1

Aggregate Unemployment Rates, Actual and Steady State Natural Rate



Source Economic Council of Canada, 1989.

Table 3

Steady State Natural and Actual Rates of Unemployment

	SNRU	Actual
1963	4.37	5.49
1964	4.77	4.65
1965	4.33	3.86
1966	4.80	3.33
1967	5.02	3.82
1968	5.44	4.48
1969	5.46	4.42
1970	6.46	5.71
1971	6.25	6.19
1972	6.48	6.23
1973	6.26	5.54
1974	6.52	5.33
1975	7.25	6.92
1976	7.35	7.13
1977	7.54	8.10
1978	7.06	8.34
1979	6.71	7.42
1980	7.16	7.46
1981	7.99	7.55
1982	9.65	11.07
1983	8.49	11.87
1984	8.66	11.28
1985	8.92	10.51
1986	7.94	9.60
1987	7.66	9.21

8.66 per cent, which is in line with McCallum's (1986) estimate of 8.5 per cent; it is considerably lower than our projection of Samson's estimate of 9.88 per cent and considerably higher than Fortin's estimate of 6.9 per cent. This result implies that critics of the Samson/Lilien technique are correct in suggesting that some of the effect being proxied by SIG in these regressions is cyclical in nature. However, it also is generally supportive of the argument that a substantial proportion of the increase in the unemployment rate in the early 1980s (almost 50 per cent) is attributable to structural factors.[25]

Confining our discussion to the long-run, steady-state, natural rate concept, we find a story consistent with common wisdom as to the economy's position with respect to its potential. The period 1962-64 was a period of economic recovery. In the late 1960s the economy was operating above capacity, fuelled by the Vietnam war effort, with

labour markets very tight. By the early 1970s the U.S. pullout had begun and a light recession was observed. The period 1973-1977 is consistent with markets being approximately at or near their full-employment levels. This was a period of relatively rapidly rising inflation, except when wage and price controls were in effect (1976-78). The implication, given that markets were tighter in the sixties, is that the inflation of the 1970s was **not** of the wage push kind. Chart I indicates that the economy went into a major recession in 1982 and that although there has been considerable economic recovery over this period in terms of increased employment and decreased unemployment, the natural rate has been declining at a smilar rate, with the net result that, although the unemployment gap which existed in 1982 has been greatly reduced, there remains a certain element of cyclical unemployment in 1987Q2.

Contributions to Changes in the NRU

As outlined earlier, one of the problems with using a reduced-form expression for unemployment is the difficulty in sorting out influences. One must be very careful before making statements of the type "x caused y". This is especially true for those variables which are thought likely to have an impact on both the cyclical and the frictional/structural components of unemployment.

Despite the interpretational difficulties inherent with estimates based on a reduced-form, it is important that the exercise of calculating the relative contributions of different factors be undertaken, if for no other reason than to gauge the reduced-form itself. By judging the economic reasonableness of different estimated contributions, one can form a judgment with respect to the regression's usefulness for policy recommendations.

Because our expression for the SNRU is exponential, the contribution of individual factors enters multiplicatively:

$$SNRU_t = \prod_{i=2}^{n} e^{\frac{X_{it}\beta_i}{1-\beta_1}} \qquad (6)$$

This in turn implies that the exact calculation of the contribution of any one variable to changes in the SNRU can only be approximated. Marston (1976) discusses the indexing problems involved. Calculation of the marginal contribution of a factor to the SNRU depends upon the value of the SNRU at the point where the calculation is made. As a result, comparative static simulations based upon holding one factor constant while the others vary will not yield the same estimate of a factor's contribution as would calculations based upon a comparative static experiment where all factors except one were held constant. The first simulation will tend to be biased upwards while the second will tend to be biased downwards.

Appendix C details the manner in which the reported contributions were calculated. In brief our methodology permits an estimate of the individual contributions to changes in the SNRU which add up almost exactly to the actual changes in SNRU.[26]

Charts 2, 3, 4 and 5 show a quarterly break down of the six separate components of the SNRU and their contribution to changes in the SNRU over time. Table 4 shows the same information in numeric (annualized) form.

The partitioning of effects tends to confirm the casual observation that a considerable amount of the recent rises in unemployment is attributable to the oil shocks of the 1970s. There are two avenues by which the unemployment modelled by RLPENERG could arise. The first follows from a Baily (1981) type scenario, where increasing energy prices cause capital to be less productive and to be depreciated at a more rapid rate, resulting in increases in structural employment in some sectors. The U.S. steel industry serves as an example of an industry afflicted in this manner.

The second rises as a result of changes in the **pattern** of demand caused by the relative price changes implied by the price shock. It is our contention that industries such as the auto industry were dramatically affected by a substitution away from goods which are complements to energy in consumption towards goods which are either less complementary (foreign autos) or substitutes. In fact, over 60 per cent of the variation in the Canadian sales of North American produced cars over the sample period can be explained by changes in the relative price of energy alone.[27] To the extent that changes in the pattern of demand hurts some sectors more than others, the

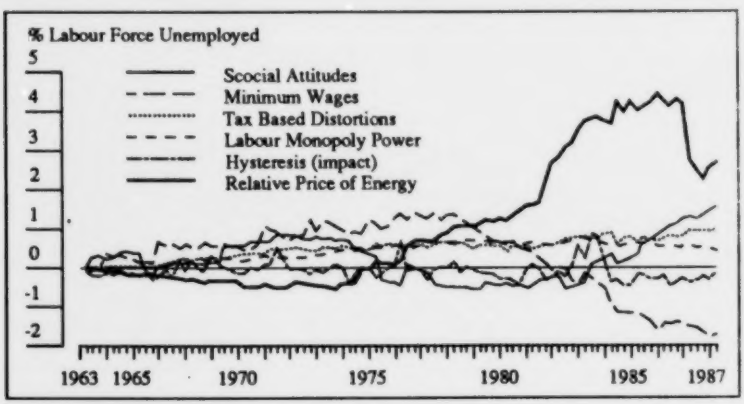
unemployment attributable to changes in RLPENERG can be considered structural unemployment. To the extent that the unemployment is the result of a more general phenomenon such as an unanticipated reduction in productivity, it can be classified as "classical" in nature.

Examining Table 4 and Chart 3 we observe that the magnitude of the contribution of increased energy costs to the natural rate, both "classical" and "structural", is approximately 1.74 percentage points over the period 1963-1980; the relative shares of structural and classical unemployment are unidentified. The period 1981-1985 witnesses a further 2.54 point increase in the natural rate attributed to energy prices, followed by a large drop in 1986-87 (1.69 per cent). Over the same period (1963-1985), the actual unemployment rate rose by 5.01 percentage points; it has been on a slow downward trend since.

The contemporaneous rise in the natural rate is less than energy's contribution to the increase because many of the other determinants of the SNRU were in decline over this period. Our estimates of the SNRU and the energy based component of the SNRU are consistent

Chart 2

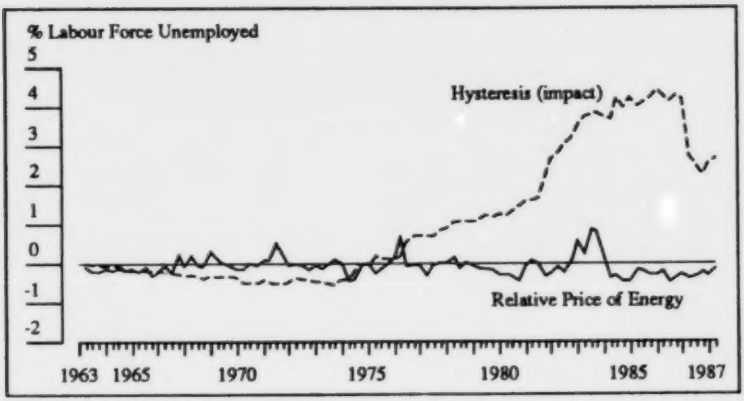
Contributions to Changes in the SNRU, Various Factors



Source Economic Council of Canada, 1989.

Chart 3

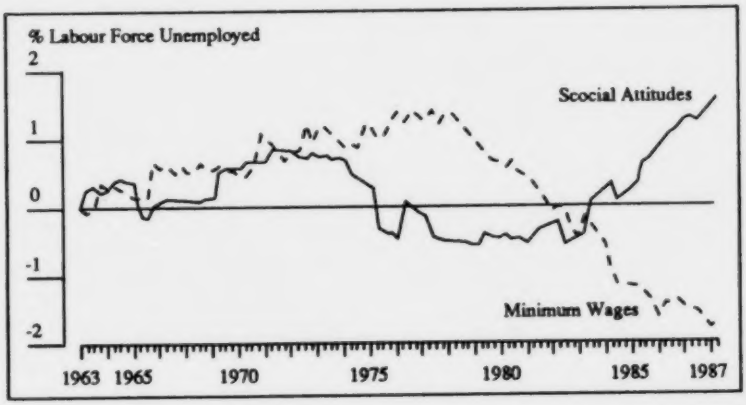
Contributions to Changes in the SNRU, Various Factors



Source Economic Council of Canada, 1989.

Chart 4

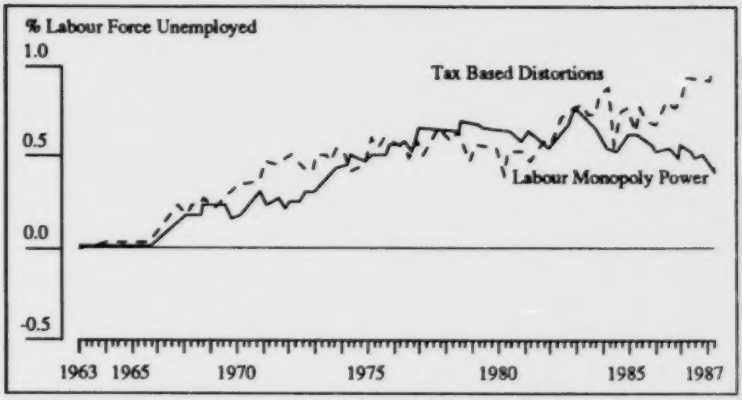
Contributions to Changes in the SNRU, Various Factors



Source Economic Council of Canada, 1989.

Chart 5

Contributions to Changes in the SNRU, Various Factors



Source Economic Council of Canada, 1989.

both with a high level of cyclical unemployment in 1982 and with a substantial rise in the structural component of unemployment. It supports, therefore, Lilien and Samson's argument that much of the increase in unemployment in 1982 was structural but falls well short of their further conclusion that there was almost no cyclical unemployment at that time.

MSERM is our proxy for social attitudes towards work. Its contribution to the SNRU (see Chart 4, Table 4) is relatively small in absolute terms but follows a pattern consistent with expectations. MSERM's contribution increases in the 1960s, peaking in 1970 with an average contribution (in 1971) to the increase in SNRU of .79. It reaches a plateau during the early 1970s until roughly 1974, when it drops to an almost neutral position, averaging a -.33 contribution to unemployment in the period 1974-1982. In 1982-1983 MSERM's contribution begins to trend upward, reaching a global maximum at the end of the sample period of a 1.50 point increase in the SNRU (with respect to 1963).

Of all the variables we deal with, MSERM is the most open to criticism. In the discussion that follows it is important to keep clear the distinction between purely demographic effects, such as an increase in the number of youth in the labour force, which we

correct for with the Perry fixed-weight unemployment index, and factors, such as those modelled by MSERM, which affect the unemployment rate associated with a given demographic group. Both an increase in youth unemployment (as modelled by MSERM), and an increase in youth's importance in the labour force can lead to an increase in the rate of overall unemployment but only the first is controlled by the Perry fixed-weight unemployment index.

Table 4

Factors' Contribution to Changes in the SNRU

	Hyster-esis	Tax effects	Labour power	Minimum wages	Energy prices	Social attitudes
1963	-0.03	-0.00	0.00	0.04	-0.02	0.17
1964	-0.17	0.03	0.00	0.30	-0.09	0.31
1965	-0.19	0.04	0.00	0.16	-0.19	0.12
1966	-0.09	0.13	0.06	0.59	-0.24	0.07
1967	-0.02	0.21	0.18	0.57	-0.32	0.09
1968	0.08	0.27	0.22	0.56	-0.34	0.31
1969	-0.09	0.37	0.22	0.51	-0.46	0.62
1970	0.22	0.44	0.27	0.93	-0.49	0.76
1971	-0.08	0.48	0.26	0.88	-0.41	0.79
1972	-0.03	0.49	0.36	1.09	-0.51	0.74
1973	-0.23	0.49	0.47	0.90	-0.28	0.56
1974	-0.12	0.55	0.50	1.09	0.08	-0.01
1975	0.19	0.56	0.56	1.32	0.37	-0.20
1976	-0.11	0.59	0.66	1.30	0.72	-0.27
1977	0.00	0.62	0.68	1.26	1.02	-0.51
1978	-0.12	0.54	0.69	0.85	1.13	-0.48
1979	-0.35	0.51	0.65	0.60	1.30	-0.46
1980	-0.10	0.53	0.62	0.30	1.74	-0.40
1981	-0.14	0.65	0.61	-0.10	2.93	-0.40
1982	0.61	0.76	0.72	-0.31	3.73	-0.16
1983	-0.27	0.76	0.58	-0.93	3.90	0.20
1984	-0.26	0.72	0.61	-1.24	4.13	0.47
1985	-0.35	0.76	0.55	-1.47	4.28	0.96
1986	-0.29	0.90	0.53	-1.57	2.91	1.28
1987	-0.19	0.95	0.45	-1.76	2.59	1.50

The least objectionable explanation for the importance of MSERM in our regression is that it models changes in the unemployment rate deriving from changed attitudes within the youth labour force alone.[28] The magnitude of the measure seems in line with this interpretation. A .79 point increase in the aggregate unemployment rate could be accounted for by a 3.04 point increase in the youth unemployment rate.[29] Given that full employment youth unemployment rates have

increased by more than 7.5 per cent,[30] it is not improbable that 3.04 points of this increase could be accounted for by increases in the "statistically unemployed." On the other hand, it could be argued that the variable is reflecting cyclical factors. This is especially true for the 1980-1987 period, where there is less reason to expect that there was an exogenous shift in youth preferences. If this is indeed a reflection of cyclical effects and MSERM is excluded from our regressions then our estimate of the SNRU would increase by 0.4 points in 1987Q2 to reach a value of 8.06 per cent.[31]

The minimum wage, average industrial wage ratio is meant to capture the structural unemployment causing effects of increases in minimum wages. The period 1963 to 1975 saw minimum wages rising relative to average industrial wages and, presumably, with respect to productivity. Our regression suggests that over this period rising minimum wages contributed to a 1.32 point increase in the SNRU. Since 1976 minimum wages have been falling relative to industrial wages. This fall has contributed to a 3.08 point drop in the natural rate between 1975 and 1987. Overall between 1963 and 1987 lower relative minimum wages have accounted for a drop of 1.76 points in the unemployment rate.

Our expectation is that the jobs lost and created due to factors modelled by WMR would be low productivity and low pay jobs. The post 1976 period has seen an important increase in employment in the service sector which traditionally has more low pay/low productivity positions. This trend is both dramatic and supportive of our estimate of the contribution of WMR to changes in the SNRU.

The final two effects (see Chart 5), before dealing with hysteresis are those of labour power as proxied by the percentage of the labour force in unions and tax based distortions. Both variables are highly correlated and the magnitude of the effect on the SNRU is roughly similar. UNION's contribution follows a roughly concave time path suggesting that labour militancy and wage push factors stemming from a Keynesian struggle over the national product contributed to a 0.72 point increase in the SNRU at its peak in 1982 and has since been on the decline, accounting now for only a 0.45 point increase in SNRU since 1963. This account seems roughly in tune with prior expectations. Labour militancy rose throughout the late sixties and early seventies, plateaued in the late seventies and has declined in the Reagan years. The magnitude of the overall impact of labour

militancy seems neither excessively high nor low.

Similarly the effects of the tax burden rose through out the sixties, remained roughly constant during the seventies, increased in the early eighties and have since levelled off. The magnitude of this effect (c. a 0.59 per cent increase in the SNRU from 1963 until 1976 and then a further 0.36 increase since) is neither excessively large nor small.

As is the case with labour monopoly power it may well be that this effect is merely the reflection of a time trend. Because both variables and the unemployment rate itself are highly correlated with time[32] it is difficult to state with confidence that x per cent of the increase in the SNRU can be attributed to either of these factors. This difficulty is reflected in the sensitivity of their estimated coefficients to the exclusion of the other variable. Exclusion of BDTAX results in a tripling of UNION's estimated coefficient while the exclusion of UNION has a similar effect on BDTAX. Of all the estimated contributions these are the most susceptible to error.

Modelling the impact of hysteresis in the economy is not as straight forward as it was for the other secular variables. The variable HYSTERESIS contributes directly to the steady state natural rate of unemployment (SNRU). It serves as an avenue whereby both demand and supply shocks can increase the SNRU. The degree to which a given shock impacts the SNRU being a positive function of the degree to which labour markets can be characterised by insider-outsider behaviour. The variable HYSTERESIS' effect (see Chart 3) is not tremendously important over most of the period under examination. At it's peak, in 1982Q3 it contributes a 0.9 percentage point increase to the natural rate, while its mean contribution is -0.04.

The coefficient on lagged unemployment β_1 dictates the amount of time it takes for the long run effects of a change in a structural variable, measured and discussed above, to impact fully. As β_1 increases a given bout of unemployment becomes more persistent. By dynamically simulating equation (4) we get a measure of a state dependent natural rate of unemployment (DNRU) where the DNRU at time t depends upon the impact multiplier of contemporaneous shocks and the extent to which previous shocks have already been absorbed into the level of the DNRU.

Chart 6 shows the DNRU, SNRU and the UR. Chart 7 shows the difference between a dynamic simulation of equation (4) (DNRU) which allows for persistence effects and the steady state NRU (SNRU) which considers only the long run effects of structural change. Table 5 reproduces the same information in tabular (annualized) form.

Table 5

Natural Rates of Unemployment

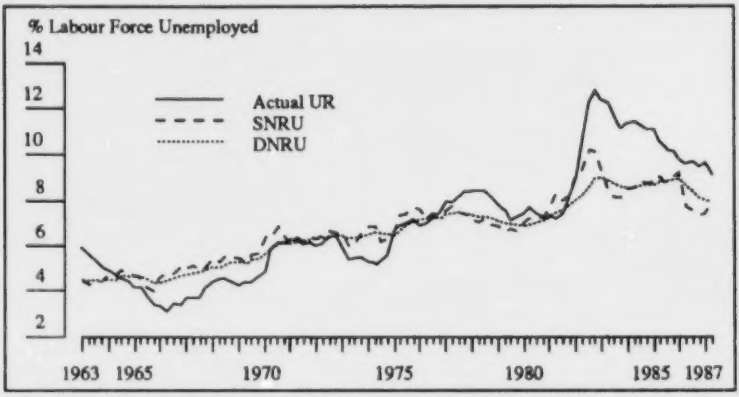
	SNRU	DNRU	SNRU -DNRU	UR
1963	4.37	4.45	-0.08	5.49
1964	4.77	4.56	0.20	4.65
1965	4.33	4.54	-0.21	3.86
1966	4.80	4.48	0.31	3.33
1967	5.02	4.84	0.18	3.82
1968	5.44	5.15	0.29	4.48
1969	5.46	5.33	0.13	4.42
1970	6.46	5.90	0.56	5.71
1971	6.25	6.16	0.08	6.19
1972	6.48	6.33	0.15	6.23
1973	6.26	6.36	-0.10	5.54
1974	7.25	6.49	0.04	5.23
1975	7.25	6.76	0.49	6.92
1976	7.35	7.19	0.16	7.13
1977	7.54	7.40	0.14	8.10
1978	7.06	7.26	-0.20	8.34
1979	6.71	6.97	-0.26	7.42
1980	7.16	6.98	0.18	7.46
1981	7.99	7.46	0.54	7.55
1982	9.65	8.42	1.22	11.07
1983	8.49	8.78	-0.28	11.87
1984	8.66	8.59	0.07	11.28
1985	8.92	8.76	0.16	10.51
1986	7.94	8.49	-0.55	9.60
1987	7.65	4.71	2.95	9.21

The difference between the DNRU and the SNRU is an imperfect measure of the increase in the unemployment rate attributable to "persistence" or frictional unemployment. It is a measure of the amount of cyclical unemployment (defined as the difference between unemployment and the steady state level of unemployment) at any time which can be attributed to previous supply and demand

shocks[33]. Barro (1988) has examined the determinants of unemployment persistence.[34]

Chart 6

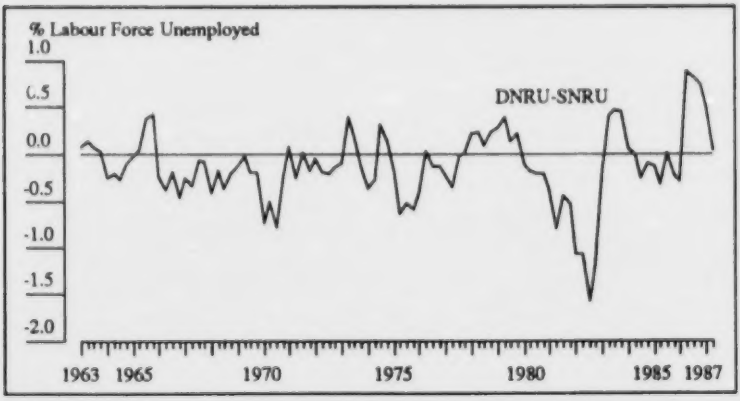
Aggregate Unemployment Rates, Historical, Steady State and Dynamic Natural Rates



Source Economic Council of Canada, 1989.

Chart 7

Frictional Unemployment Due to Persistence



Source Economic Council of Canada, 1989.

It is in the nature of our measure that in the presence of a rising unemployment rate frictional unemployment will be negative; implying that structural unemployment rates are lower than they would be were all effects to have been worked out. Similarly, in the face of declining unemployment rates our measure of frictional unemployment will be positive. Thus in the period 1963-1977, a period of rising unemployment (both structural and actual), the dynamic natural rate exceeds the steady state (see Chart 6). Since 1978 the dynamic rate has exceeded the structural reflecting the relative sluggish response of the economy to structural improvements.

Research by Hasan & de Broucker (1981, 1982) tends to support both the hysteresis/persistence argument and our quantification of its importance. Hasan & de Broucker follow up on Clark and Summer's (1979) and Marston's (1976) work by studying the duration of unemployment in Canada and the contribution of unemployment of various durations to the aggregate unemployment rate. They find that the probability of finding a job decreases as the duration of unemployment increases, a result which follows directly from the Summers & Blanchard's insider-outsider membership model. More explicitly they find that between 1976 and 1980 the amount of unemployment which can be attributed to long term unemployment (spells lasting more than six months) rose by .415 percentage points suggesting that a larger proportion of the unemployed have become external (made outsiders) to the labour market. Our estimate of the increase in frictional unemployment between 1976 and 1983 is of a similar order (.36 per cent).[35] As hysterically or persistently unemployed workers are more likely to be long term unemployed the Hasan & de Broucker estimate tends to confirm our quantification of persistence.

Some further tentative support for the hysteresis/persistence effect is provided by McCallum's (1987) analysis. McCallum concludes that although his model, which fails to account for hysteresis, succeeds in modelling much of unemployment's recent history it "provides no explanation for the relatively slow decline in Canadian unemployment since 1983". It is precisely such a slow decline that hysteresis theory predicts and which our modelling of the natural rate of unemployment reflects.

In a real way the hysteresis phenomenon is a vindication of the old adage that work is habit forming. The restraint policies undertaken

by successive governments plus the cumulative effect of a series of negative supply shocks resulted in a large pool of workers competing for a limited number of openings. The dynamics of the model are such that given a stable environment over a period of some five years the DNRU will rejoin the SNRU. In the interim, however, a significant number of workers will not be able to find work due to the economy's slow response time.

Comparison of the DNRU to historical unemployment rates yields a story somewhat different from that implied by the SNRU. In fact, because Samson's natural rate of unemployment was also dynamically simulated there is the possibility that the unusually high natural rates which Samson reports are more a function of the manner in which they were calculated from her regression than a result of the use of the SIG variable.[36]

Despite disagreement on the quantification of the natural rate both the DNRU and the SNRU broadly agree that there was substantial cyclical unemployment in 1982, that the natural rate of unemployment is presently falling at approximately the same rate as the unemployment rate itself, and that labour markets are presently less tight than they were in the 1970s and 1960s.[37]

As Hargreaves Heap noted the existence of hysteresis confuses in a very real way the notion of a natural rate of unemployment. If the natural rate is a function of past rates of unemployment (ie. the DNRU) in what way can it be deemed "natural"? The natural rate in the way most economists think of it remains the SNRU and exists as a measure of potential in an ideal world where all adjustments are complete and instantaneous. The DNRU is state dependent, a more pragmatic or realistic measure of potential given past history. Both concepts are relevant to policy makers. The SNRU as a measure of absolute potential and the DNRU as a warning line indicating when labour market constraints are beginning to tighten up.

Conclusion

Our results reflect some of the confusion in the NRU literature and yet shed considerable light on the sources and causes of that confusion and disagreement.

We have developed two competing estimates of the natural rate of unemployment. The first corresponds to the rate of unemployment consistent with zero cyclical unemployment and a stable structural environment after all adjustments have occurred. The second, which derives from precisely the same equation as the first, is a dynamic natural rate which yields a state dependent measure. The first notion, the steady state natural rate (SNRU) corresponds to Friedman's (1968) notion of the rate of unemployment which would hold once the economy had achieved Walrasian equilibrium. The second notion (DNRU) falls more into the paradigm of Hargreaves Heap or Summers & Blanchard where the natural rate of unemployment today depends directly on past unemployment experience.

The SNRU yields estimates which fall roughly in between the highest and lowest estimates in the literature. It is consistent with the conclusion that there has been a considerable decrease in the amount of slack in labour markets although there remains some margin for further improvement. The state dependent notion (DNRU) suggests that, given our past unemployment history and the present degree of job market flexibility, labour markets are relatively tight.[38] Both notions suggest that the natural rate of unemployment is declining at a rate approximately equal to the rate of decline of the actual unemployment rate.

Our results tend to confirm suspicions about the utility of SIG as a measure of structural unemployment. Nonetheless they support Lilien's hypothesis that much of the increase in unemployment rates witnessed over the seventies was structural in nature. This support comes despite our rejection of Lilien's structural proxy SIG and derives from the theoretical implications of the effects attributed to RLPENERG.

Our results suggest that some of present unemployment can be attributed to increased labour monopoly power and the distortions introduced by the tax system. Our confidence in the estimates of these factors' influence is tempered, however, by the high degree of correlation between themselves, time and the unemployment rate. They could very easily be proxying for some other factor.

Our estimate of the influence of the minimum/industrial wage variable suggests support to the notion that much of the recent employment creation has been in the low productivity/low pay service

sector. Our proxy for social attitudes suggests a limited role for this variable in the sixties and early seventies and again in the eighties. Our estimates of the SNRU are robust to the exclusion of this variable.

Overall our methodology provides us with a detailed picture of the nature of the rise in unemployment over the last decade. Unemployment's rise is seen largely as a function of two factors: the radical increase in the relative price of energy as a factor of production and the failure of the economy to adapt quickly enough to shocks in the labour market.

With respect to the structural/frictional debate our results, like McCallum's, suggest that a considerable degree of the increase in the unemployment rate can be attributed to structural factors. However, in contrast to the Lilien and Samson estimates we find that there has also been a considerable cyclical element in recent years. Thus while the structural hypothesis is in some ways vindicated by our analysis there is also support for the Keynesian view.

Our findings suggest that a significant proportion of present unemployment can be attributed to a failure of the economy to rapidly adjust to supply and demand side shocks. Policy aimed at reducing the amount of time which a worker requires before finding new employment, thereby reducing the persistence of unemployment, could reduce the rate of unemployment by as much as 1.2 percentage points.

Our findings with respect to the persistence of unemployment have important implications for counter-cyclical policy. For example, given the parameters of our model, of the 213 thousand people who were cyclically unemployed in January 1983, 69 thousand would have remained unemployed in January 1984, 22 thousand in January 1985, seven thousand in January 1986 and in January 1987 four years later, two thousand five hundred people would remain unemployed for reasons directly related to the cyclical shock in 1983.[39] The clear implication is that even short lived shocks to the system will have serious long-run effects. A policy mix aimed at a) minimizing the size of such shocks and b) reducing the sluggishness of labour markets to adapt to such shocks would have significant effects on the unemployment rate and the pragmatic DNRU at any given point in time.

Appendixes

Appendix A

Anticipated monetary policy and unanticipated monetary shocks were modelled as in Samson(1985). Our equation for M1 and regression results are reported below.

QUARTERLY data for 98 periods from 1963Q1 to 1987Q2

$$
\begin{aligned}
\text{dlog(M1)} = {} & 0.39924 \ast \text{dlog(M1)[-1]} - 0.07266 \ast \text{dlog(M1)[-2]} \\
& (4.16610) \qquad\qquad (0.80895) \\
& + 0.38850 \ast \text{dlog(M1)[-3]} - 0.29373 \ast \text{dlog(M1)[-4]} \\
& (4.24938) \qquad\qquad (3.18635) \\
& - 0.08236 \ast \text{FEDV[-3]} + 0.10094 \ast \text{FEDV[-4]} \\
& (1.87338) \qquad\qquad (2.33571) \\
& - 0.06065 \ast \text{UT[-4]} \\
& (2.17673) \\
& + 0.05034 \ast \text{UT[-5]} + 0.84666 \ast \text{dlog(USM1)} \\
& (1.81582) \qquad\qquad (4.23219) \\
& + 0.01697 \\
& (2.04401)
\end{aligned}
$$

Sum Sq	0.0185	Std Err	0.0145	LHS Mean	0.0185
R Sq	0.3950	R Bar Sq	0.3331	F 9, 88	6.3839

The variable FEDV was constructed as the rate of growth of unanticipated federal expenditures where anticipated expenditures were derived from a simple autoregressive regression. UT is, as in Samson, simply a normalization of the unemployment rate [1/(1-UR)] while USM1 is the M1 money aggregate for the United States. The variable DMR1 used throughout the paper is defined as the residual from the above equation. The variable MONPOL is defined as the difference between the anticipated portion of monetary policy and a "neutral" monetary policy where a neutral monetary policy is defined as one where the rate of monetary expansion is precisely equal to the actual rate of inflation.

Appendix B

If the secular rise in unemployment rates is a function of demographic factors then the Perry fixed weight unemployment rate (which is independent of these factors) should show almost no trend. Therefore, if the difference between the Perry fixed weight index and the unemployment rate shows the same trend as the unemployment rate and is of the same magnitude then one could argue that the secular rise in unemployment experienced over the last 25 years was largely a demographic phenomenon.

Table B-1 shows the difference between the Perry unemployment rate and the measured unemployment rate. It is clear that the difference between the two has been small both in absolute and percentage terms. Although the difference follows a trend similar to that of the historical drift in unemployment rates, the differences have not been anywhere near the same magnitude.

The clear implication is that the rise in unemployment rates has had causes other than purely compositional changes in the labour force. On the basis of the largest differences, (-.11 and +.21 percentage points), purely demographic factors were responsible for a maximum of .32 percentage points change in the measured unemployment rate.[1] This result is not inconsistent with other work done in the Canadian context (see Reid & Smith (1981)).

Table B-1

Actual and Perry Fixed Weight Unemployment Rates, Difference and Per cent Difference

	Actual	Fixed weight	Δ	Per cent Δ
1963	5.49	5.32	0.17	3.07
1964	4.65	4.54	0.11	2.28
1965	3.86	3.77	0.09	2.45
1966	3.33	3.34	-0.00	-0.15
1967	3.82	3.81	0.02	0.41
1968	4.48	4.44	0.03	0.76
1969	4.42	4.41	0.01	0.16
1970	5.71	5.66	0.05	0.81
1971	6.19	6.14	0.05	0.78
1972	6.23	6.18	0.06	0.88
1973	5.54	5.47	0.08	1.37
1974	5.33	5.22	0.12	2.16
1975	6.92	6.76	0.16	2.35
1976	7.13	6.95	0.17	2.43
1977	8.10	7.89	0.21	2.56
1978	8.34	8.13	0.20	2.45
1979	7.42	7.22	0.21	2.77
1980	7.46	7.27	0.19	2.56
1981	7.55	7.38	0.16	2.12
1982	11.07	11.04	0.02	0.21
1983	11.87	11.93	-0.06	-0.49
1984	11.28	11.34	-0.06	-0.52
1985	10.51	10.60	-0.09	-0.85
1986	9.60	9.70	-0.10	-1.07
1987	9.21	9.32	-0.11	-1.25

Appendix C

Separating the change in the SNRU into its component parts is not straightforward. Complications arise because the functional form of equation (6) is non-linear. As a result the value of the derivative with respect to any given argument depends upon where that derivative is taken. In general terms our equation for the SNRU can be represented as below.

$$SNRU_t = e^{\alpha} \cdot e^{f_1(X_{1t})} \cdot e^{f_2(X_{2t})} \ldots e^{f_n(X_{nt})} \qquad \text{(C-1)}$$

In this case, given a change in X_i ($\Delta X_i = X_{i,t} - X_{i,t-1}$), the estimated change using the derivative evaluated at t ($\Delta SNRU1_{i,t}$) and at t-1 ($\Delta SNRU2_{i,t}$) will not be the same.

$$\Delta SNRU1_{i,t} = SNRU_t \cdot f_i'(X_{i,t}) \cdot \Delta X_t \qquad \text{(C-2)}$$

$$\Delta SNRU2_{i,t} = SNRU_{t-1} \cdot f_i'(X_{i,t-1}) \cdot \Delta X_t \qquad \text{(C-3)}$$

Marston (1976) has dealt with this problem in a somewhat different context.[1] His solution, with some modification, is directly applicable. Marston estimated the impact of variable i on changes in the unemployment rate by first summing (C-2) and (C-3) over i to derive expressions for $\Delta SNRU_{1,t}$ and $\Delta SNRU_{2,t}$. Unlike Marston's model which has only one paired estimate of the effect of ΔX_i on the unemployment rate, our model has 98 (1963Q1-1987Q4) paired estimates one for each t, t-1 pair. Marston was able to calculate exactly a weight W such that

$$\Delta SNRU_t = W \cdot \Delta SNRU1_t + (1-W) \cdot \Delta SNRU2_t. \qquad \text{(C-4)}$$

In a similar manner, we could calculate a different W for each t, where the W which assures adding up is given by

$$W_t = \frac{\Delta SNRU_t - \Delta SNRU2_t}{\Delta SNRU1_t - \Delta SNRU2_t} \qquad \text{(C-5)}$$

or alternatively we could calculate an average W_t using least squares.

Using the method of calculating time varying W's would eliminate any error but leaves the weighting methodology open to charges of arbitrariness,[2] (because W is allowed to vary with time without any theoretical rationale). It is, therefore, the second method which we chose to follow.

The regression below estimates W by regressing the actual changes in the SNRU on our two estimates with the sum of the coefficients constrained to equal one. The coefficient on $\Delta SNRU2_t$-$\Delta SNRU_t$ is a least squares estimate of W. We define $\Delta SNRU3_t$

$$\Delta SNRU3_t = \hat{W} \cdot \Delta SNRU_{2,t} + (1-\hat{W}) \cdot \Delta SNRU_{1,t} \qquad \text{(C-6)}$$

as an estimate of the changes (between t, t-1) in the SNRU attributable to the 6 factors we have identified.

A further difference arises in that the ΔSNRUs that we calculate are the changes in the SNRU from one quarter to the next (in Marston's case from male to female). What interests us are the cumulative changes from 1963Q1 to 1987Q2. Since we have a time invariant estimate of W_t, namely $\hat{W}$, we are able to transform our data by taking the sum of all estimated incremental changes from 1963Q1 to t for $\Delta SNRU3_t$ to obtain $\Sigma\Delta SNRU3_t$ where the summation runs from T=1963Q1 to t.[3]

Table C-1 shows the annualized values of $\Sigma\Delta SNRU_t$ and $\Sigma\Delta SNRU_{3,t}$ and their difference, while Chart C-1 represents the estimate and actual values in quarterly form. The estimation error is small both in absolute and relative terms. The charts and tables reproduced in the text, showing the contribution of component (i) to the SNRU, are calculated using $\hat{W}$= .49586 from the regression reported below. Because $\hat{W}$ is time invariant they can be calculated as:

$$\Sigma\Delta SNRU_{3,i,t} = \hat{W} \cdot \Sigma\Delta SNRU_{1,i,t} + (1-\hat{W}) \cdot \Sigma\Delta SNRU_{2,i,t} \qquad \text{(C-7)}$$

for all i=1..6. Where, once again, the summation runs from T=63Q1 to t for all t=63Q1..87Q2.

QUARTERLY data for 98 periods from 1963Q1 to 1987Q2

$$[\Delta SNRU_t - \Delta SNRU1_t] = 0.49586 * [\Delta SNRU2_t - \Delta SNRU1_t]$$
$$(432.26)$$

Sum Sq	0.0000
Std Err	0.0004
LHS Mean	-0.0093
R Sq	0.9993
R Bar Sq	0.9993
F 1, 97	144209.
D.W.(1)	1.9248
D.W.(4)	2.1182

Table C-1

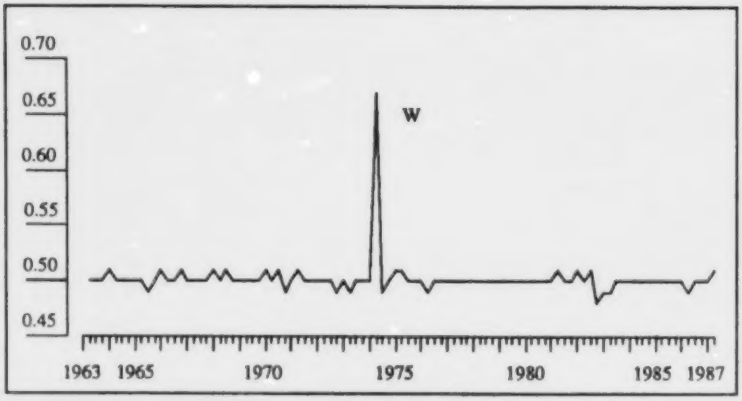
Estimated Changes in SNRU versus Actual

	Estimated[1]	Actual[2]	Δ
1963	-0.07	0.00	-0.07
1964	0.38	0.40	-0.02
1965	-0.06	-0.04	-0.02
1966	0.52	0.43	0.09
1967	0.72	0.65	0.07
1968	1.12	1.07	0.05
1969	1.17	1.09	0.08
1970	2.15	2.10	0.05
1971	1.93	1.88	0.05
1972	2.16	2.11	0.05
1973	1.92	1.89	0.03
1974	2.15	2.15	-0.00
1975	2.87	2.88	-0.01
1976	2.96	2.98	-0.02
1977	3.15	3.18	-0.02
1978	2.68	2.70	-0.02
1979	2.31	2.34	-0.03
1980	2.77	2.79	-0.02
1981	3.62	3.63	-0.00
1982	5.36	5.28	0.08
1983	4.23	4.12	0.11
1984	4.40	4.29	0.11
1985	4.68	4.56	0.13
1986	3.71	3.57	0.14
1987	3.46	3.29	0.17

1 Sum of individual components as recorded in Table 4.
2 Difference between $SNRU_t$ and $SNRU_{63Q1}$.

Chart C-1

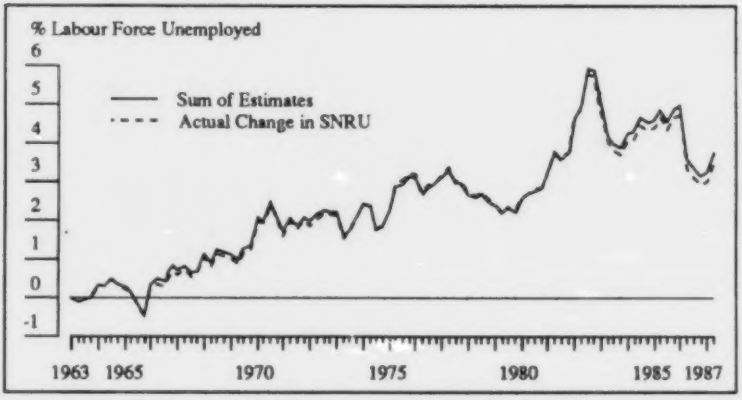
Exact Weights
Calculated as per C-5



Source Economic Council of Canada, 1989.

Chart C-2

Changes in SNRU
Actual and Estimates



Source Economic Council of Canada, 1989.

Appendix D

Table D-1 reproduces regression (7) from the main text (see Table 2) as regression (D-1). Regression (D-2) demonstrates the effects of excluding MSERM from regression (7). In regression (D-2) MSERM is dropped. The null hypothesis that MSERM's coefficient in (D-1) is equal to zero is rejected ($F(1,84) = 4.23$). With the exception of UNION coefficient estimates remain relatively stable. There is an increase in the estimated value of β_1 which is offset by declines in the estimated coefficients for all the other variables, with the exception of BDTAX and UNION.

As noted in the body of the text these variables are highly correlated and inefficiently estimated. Exclusion of MSERM would appear to have added a bias to their estimates.

The steady state natural rate based on equation (D-2) is reported in Table D-2 and is represented in Chart D-1 as is the natural rate as calculated in the text. The two estimates are roughly similar with the exception being the early period of estimation where the estimate which excludes MSERM tends to be lower than that which includes it.

As is well known exclusion of important explanatory variables yields inefficient and biased estimates while inclusion of irrelevant variables does not bias estimates. On these grounds and because MSERM is statistically significant and its exclusion does not affect the estimated impact of variables in whose estimates we held some confidence we feel justified in maintaining MSERM in our model of the unemployment rate.

Table D-1

Regression Results with MSERM Included and Excluded

	(D-1)	(D-2)
Ln $PERRY_{t-1}$	0.7579	0.8087
	(16.84)	(20.74)
CUR	-0.0060	-0.0047
	(3.67)	(3.03)
Ln USGAP	0.0229	0.0159
	(1.82)	(1.27)
ENERGSHK	-0.4864	-0.3887
	(3.36)	(2.77)
BDTAX	0.3182	1.3409
	(0.50)	(3.25)
HYSTERESIS	0.5253	0.6153
	(1.59)	(1.84)
MONPOL	-0.9219	-0.9078
	(2.77)	(2.67)
RLPENERG	0.3700	0.2563
	(2.74)	(2.02)
Ln WMR_{t-4}	0.2710	0.2053
	(1.86)	(1.41)
UNION	-0.2891	-0.2053
	(0.47)	(1.04)
MSERM	0.9737	
	(2.13)	
CONSTANT	0.3275	0.7340
	(1.14)	(3.37)

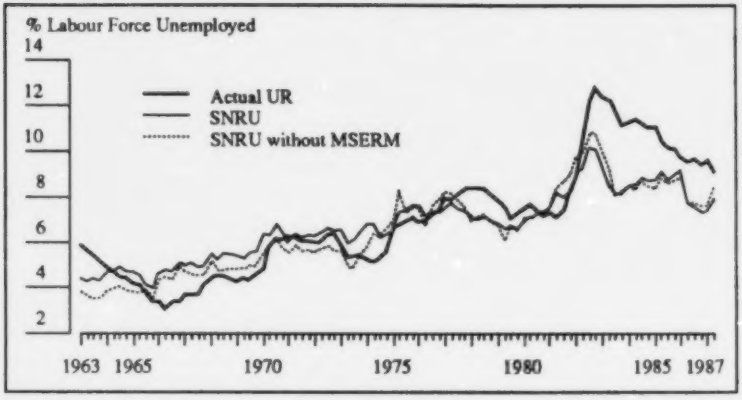
Table D-2

SNRU Calculated With and Without MSERM

	SNRU	SNRU excluding MSERM	Actual UR
1963	4.37	4.19	5.49
1964	4.77	4.49	4.65
1965	4.33	4.30	3.86
1966	4.80	5.02	3.33
1967	5.02	5.15	3.82
1968	5.44	5.50	4.48
1969	5.46	5.48	4.42
1970	6.46	6.60	5.71
1971	6.25	6.39	6.19
1972	6.48	6.41	6.23
1973	6.26	5.91	5.54
1974	6.52	6.81	5.33
1975	7.25	7.82	6.92
1976	7.35	7.62	7.13
1977	7.54	8.14	8.10
1978	7.06	7.22	8.34
1979	6.71	6.71	7.42
1980	7.16	7.37	7.46
1981	7.99	8.57	7.55
1982	9.65	10.37	11.07
1983	8.49	8.86	11.87
1984	8.66	8.46	11.28
1985	8.92	8.54	10.51
1986	7.94	7.90	9.60
1987	7.66	8.06	9.21

Chart D-1

Aggregate Unemployment Rates
Historical, Steady State, With and Without MSERM



Source Economic Council of Canada, 1989.

Data Appendix

LPERRYU	Defined as the natural log of PERRYU where PERRYU was calculated as per Appendix B using data from the Conference Board of Canada (CBOC) historical data base for MTFM.
CUR	Bank of Canada's industrial capital utilization rate.
SIG	Employment dispersion variable calculated according to the formula reported in the text where e_i = employment in the construction, agricultural, commercial services, manufacturing, non-commercial services, other primary and public administration industries. Source: CBOC (MTFM).
DMR1	Unanticipated money shocks calculated as per Appendix A.
M1	Canadian M1 money aggregate. Source: CBOC (MTFM).
USM1	U.S.A. M1 money aggregate. Source: WEFA Group data base.
NRUT	U.S.A. aggregate unemployment rate. Source: WEFA Group.
USGAP	Difference between U.S. unemployment rate and the WEFA Group's estimated U.S. natural rate. Source: WEFA Group.
ENERGSHK	Difference between rate of growth of energy price index and CPI rate of growth lagged one period. Source: Statistics Canada.
RLPENERG	Energy Price index divided by CPI index. Source: Statistics Canada.

WMR	Weighted average of Canadian provincial minimum wages divided by average industrial wages. Source: Minimum wages- Labour Canada; Industrial Wages, Provincial labour shares - Statistics Canada.
UNION	Percentage of non-farm labour force who are members of unions. Source: Labour Canada Directory of Labour Organizations.
HYSTERESIS	Derived from UNION and UR, as explained in text.
UIOPP	Measure of unemployment insurance generosity. Source: Annual data from Pierre Fortin transformed into quarterly data through geometric interpolation.
INFLVAR	Eight quarter variance of inflation. Calculated from Statistics Canada CPI.
MSERM	Male youth school enrolment rates. Source: CBOC (MTFM).
BDTAX	Federal direct taxes on businesses divided by GDP. Source: CBOC (MTFM).
RINDTAX	Total indirect Taxes on Persons divided by labour income. Source: CBOC (MTFM).
RDIRTAX	Total direct taxes on Persons divided by labour income. Source: CBOC (MTFM).
MONPOL	Growth in M1 less growth in CPI.

Notes

1 The principal difference between our own and Samson's disaggregation rests in the extent to which the resource sector is disaggregated.

2 Appendix A discusses the estimation of this equation and the measurement of monetary innovations in more detail.

3 Testing to determine whether future filtered values of the unemployment rate had no effect on the level of SIG, we calculated an $F(4,91) = 2.46$, while the test for SIG's influence on UR resulted in an $F(4,91) = 0.84$. The critical value for the F test is 2.48 at the 5 per cent level and 3.56 at the 1 per cent level.

4 Similarly inconclusive results were observed when SIG was tested for Granger-Sims causality against the capital utilization rate.

5 Johnston (1984, pp. 259-265) or Judge et al., (1982, pp. 594-599) provide discussions of the ramifications of model mis-specification.

6 In a reduced form equation these omissions could be justified if the oil shock could be shown to be endogenously caused by variables included in the reduced form. In this case, however, this does not seem to be a reasonable assumption.

7 Appendix B outlines the calculation and implications of PERRYU.

8 A more detailed description of the construction of this and other variables used in this paper can be found in the Data Appendix.

9 If the reader is worried that these variable changes might invalidate the comparison we wish to make, it is worth noting that the NRU calculated from the restricted ($\beta_i = 0$ for $i = 5..17$) equation actually approximates more closely Samson's originally reported results than does the NRU calculated from regression (3) and reported in Table 1.

10 Our calculations (see Appendix B) suggest that a maximum of 0.32 percentage points of the increase in unemployment rates can

be accounted for by demographic effects. This is in marked contrast to the influence taken on by demographic proxies in reduced forms (see Fortin (1988), McCallum (1986,fn 5.)) and in line with estimates presented by Reid and Smith (1981).

11 Layard and Nickell (1986), Bean, Layard & Nickell (1986), Trivedi & Baker (1985), Bruno & Sachs (1983) among many others.

12 Baily (1981) provides a vintage model of the capital stock. His model implies that labour productivity declined over the seventies because of a devaluation of the capital stock which is not captured in standard measures of the capital stock. Hulton et al., (1987) examine the Baily argument using micro data and fail to find support for the hypothesis. Their interpretation of their results could, however, be criticised because they fail to note how the end use of the capital goods whose price they examine might be effected by the energy shocks --- and therefore how changes in derived demand might have resulted in some of the apparent anomalies they report.

13 Fortin (1984, 1989), Wilson (1985), Helliwell et al., (1985) all present models of unemployment where the rate of productivity is modelled by the level of output with respect to potential output, the relative price of inputs and supply shocks. Adams, Fenton & Larson (1987) and Fortin (1989) explicitly model the real wage gap by the relative price of energy. Like Fortin (1984) we were forced to reject the null hypothesis of an exogenous shift in productivity growth in a regression of productivity growth versus the RLPENERG and CUR.

14 In Canada, a firm's UIC premiums are not influenced by past performance. As a result there is an incentive for firms, especially seasonal firms, to use UIC as an income supplement, laying off workers for a short period of time with the implicit agreement that they will be rehired when or before their benefits expire.

Workers, on the other hand, will be induced to remain unemployed for a longer period of time, and possibly develop a weak attachment to the labour force. In addition, it can be expected that the existence of benefits will draw into the nominal

work force "workers" with a low attachment who would not otherwise participate. These "workers" perform a minimum amount of work in order to be classified as unemployed and be entitled to benefits.

15 There is the possibility of another interpretation of a positive school enrolment-unemployment correlation. Specifically, one could argue that as employment opportunities become scarce young workers choose to educate themselves. Granger-Sims causality tests using capacity utilization rates to proxy for the business cycle fail to support the hypothesis that school enrolment is Granger caused by the business cycle (the test was inconclusive as to causality). This result is bolstered by casual examination of the school enrolment rate which shows no consistent tendency to follow cycles in the economy.

16 The modelling of monetary innovations follows Samson and is described in Appendix A.

17 The model would predict therefore that the drop in oil prices in 1986 would result in a dramatic reduction in the natural rate of unemployment.

18 In fact, in a regression of the $U_t = \alpha + \beta_1 U_{t-1} + \mu_t$, where μ follows an ARMA(2,1) process, the null hypothesis that $\beta_1 = 1$ cannot be rejected at commonly used levels of significance.

19 Barro (1988) has examined the notion of persistence using historical data from some 23 countries.

20 The existence or non-existence of a significant coefficient on the HYSTERESIS variable should not be interpreted as incriminating unions *per se*. We use the percentage of the labour force who are members of unions to proxy for the true independent variable; the degree to which labour markets exhibit insider-outsider contracting behaviour.

21 An alternative explanation for the result argues that DMR1 represents unanticipated monetary authority accommodations of exogenous real shocks. A negative real shock will raise unemployment. If the monetary authority responds by a counter-

acting monetary surprise then there will be a positive, but spurious, correlation between unanticipated money growth and unemployment.

22 McCallum (1986, 1987) suggests SIG is too highly aggregated. He includes a similar variable derived from a lower disaggregation of industries particularly susceptible to structural unemployment. These variables remain significant while SIG does not. Lilien, commenting on Murphy and Topel (1987) makes the comment that the lower the level of aggregation in SIG the better it is likely to perform.

23 The SNRU calculated from (4) is identical to the SNRU calculated from (5).

24 The reported NRU is equal to the natural rate of the Perry index multiplied by one plus the percentage difference between PERRYU and the actual unemployment rate.

25 As we demonstrate below there is the further possibility that due to the manner in which it was calculated Samson's natural rate contains an element of unemployment persistence (hysteresis) which these other steady state measures have expunged.

26 The maximum deviation of the sum of factors' contribution to changes in the SNRU and actual changes in the SNRU is .22 percentage points in 87Q2 with the average deviation being .08 percentage points. See Appendix C, Table C-1 for the annualized difference.

27 A regression of the Canadian sales of N.A. made autos and the RLPENERG variable with a slope dummy for the post 1973 period and an autoregressive error term has an R^2 of 0.69. The same regression with the autoregressive term omitted has a R^2 of .54.

28 The contemporaneous rise of "attitude" based unemployment in the eighties and the recession need not deny that MSERM is modelling changes in preferences. It could well be that preferences in the eighties were changed by the pervasive and apparent inescapable unemployment which followed the second oil shock.

29 On average, youth represented 26 per cent of the labour force over the sample period. A simple algebraic manipulation allows calculation of the 3.04 figure given the 0.79 aggregate increase.

30 This is a naive estimate of youth full employment, unemployment rate based on the trend through trough method using unemployment in 66Q2, 81Q2 as reference points.

31 Appendix D outlines sensitivity tests undertaken to determine whether the estimate SNRU was sensitive to the exclusion of MSERM. The estimate of SNRU showed little tendency to change.

32 BDTAX, UNION and UR have coefficients of correlation with time of r = .91, .87, .89 respectively.

33 Cyclical unemployment is defined here as the unemployment rate less the SNRU. Because both demand and supply shocks will, in the right environment, cause the DNRU to exceed the SNRU their "persistent" effect becomes in fact a component of cyclical unemployment when measured in this way. Alternatively one could define cyclical unemployment as the difference between the actual unemployment rate and the DNRU.

34 There exists a whole literature on the probabilities of moving from an unemployed state to an employed state and vice versa. Hall (1970), Marston (1976), Clark and Summers (1979), Hasan & de Broucker (1981, 1982) are among some of the seminal references.

35 Hasan & de Broucker provide estimates of the percentage of the aggregate unemployment rate attributable to long term unemployed workers. In order to calculate the change in percentage point terms we merely multiplied by the unemployment rate for the year in question. It is a peculiarity of our "measure" of the degree of frictional unemployment, that it will underestimate the effect in years where the SNRU rises sharply. We thus use a base year later than Hasan & de Broucker's, based on the assumption that the distortions in the comparison introduced by looking at a longer time interval would be less than those introduced by using a period where we know our estimate to be biased downwards.

36 Samson argues that she uses dynamic simulation because the alternative methodology would imply the loss of too many observation points. However, as our discussion above makes clear, there is no need to lose any observation points in calculating the steady state for the NRU.

37 There are those who would argue that in Canada today the appropriate natural rate concept would be a provincial or regionally based measure. Under such a paradigm, it would be entirely possible for the aggregate economy to show apparent slack while any given region might already have achieved its natural rate or vice versa. It is our intention to pursue the estimation of regional natural rates in the near future.

38 Our model is an aggregate model. A regional disaggre-gation would permit a more precise statement about current labour market tightness, particularly the differences that exist between central Canada and the other regions.

39 The number of unemployed at this time exceeded these figures due to subsequent cyclical shocks. Our methodology prevents us from concluding that these 2,500 people were necessarily unemployed in 1983Q1. Rather, their present unemployment traces its causes to the 83 demand shock. Nonetheless, longitudinal work by Hasan & de Broucker provides evidence which is supportive of unemployment spells as long as three or four years.

APPENDIX B

1 Because the weights we used were the average proportion in the labour force there is no given year where the Perry Unemployment measure is equal to the measured unemployment rate --- except perhaps by chance.

APPENDIX C

1 Marston was attempting to partition the difference between male and female unemployment rates as a function of different exit

probabilities in a three state Markov model of unemployment flows.

2 Chart C-1 shows the Ws calculated exactly as per equation C-5. The weights remain very close to .5 suggesting that our estimates of contributions to changes are indeed close to the actual values. The spike in 1974Q2 arises because ΔSNRU1, ΔSNRU2 were extremely close to each other and the actual change. As their difference in equation C-5 approaches zero W ceases to be defined as almost any weighting scheme would provide a good approximation.

3 Given the time invariance of W it is incidental whether we sum prior to weighting or sum after weighting.

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